

VIRTUAL AIRSPACE MODELING AND SIMULATION

Technical Interchange Meeting

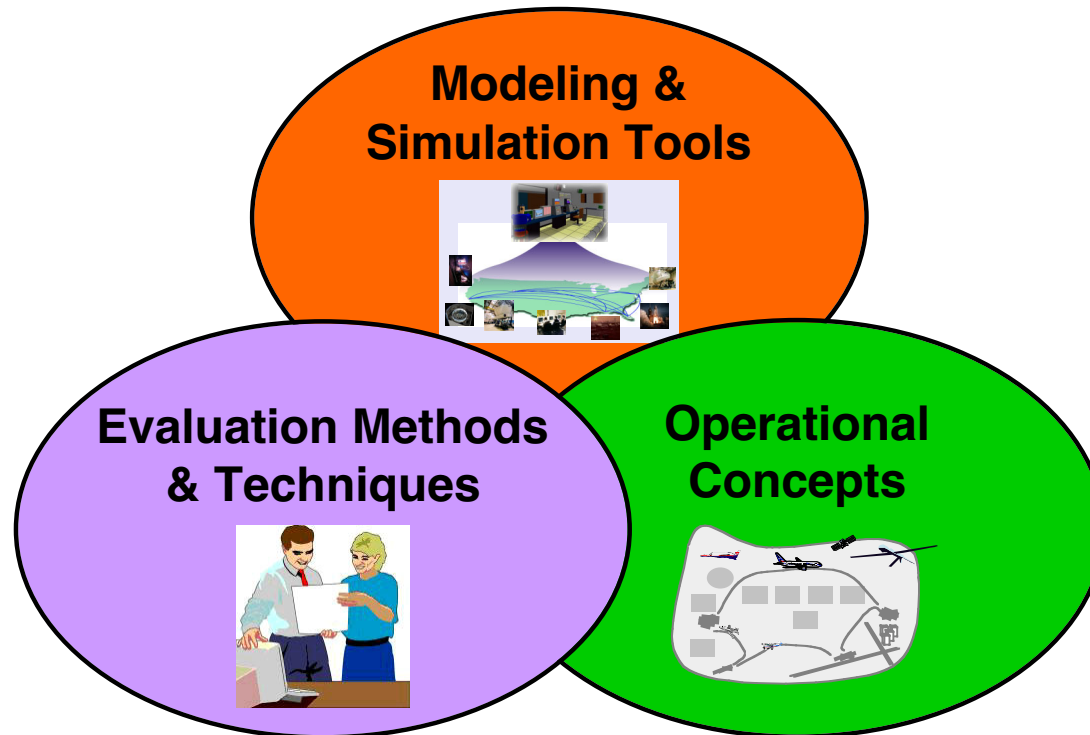


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Project Manager
NASA Ames Research Center

May 21, 2002

Project Vision

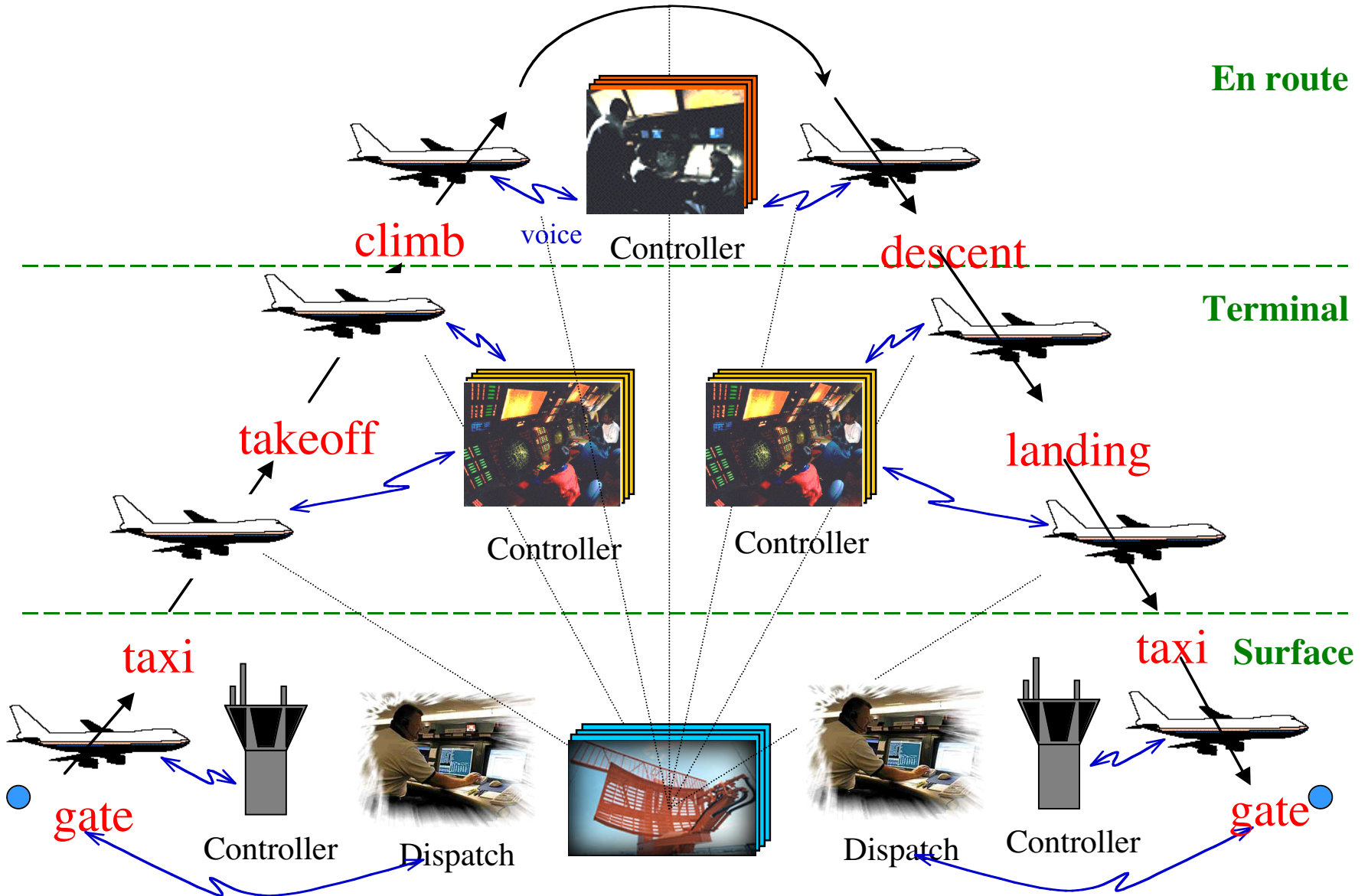
The Virtual Airspace Modeling and Simulation Project will provide the technologies and processes for conducting trade-off analyses amongst future air transportation system's concepts and technologies



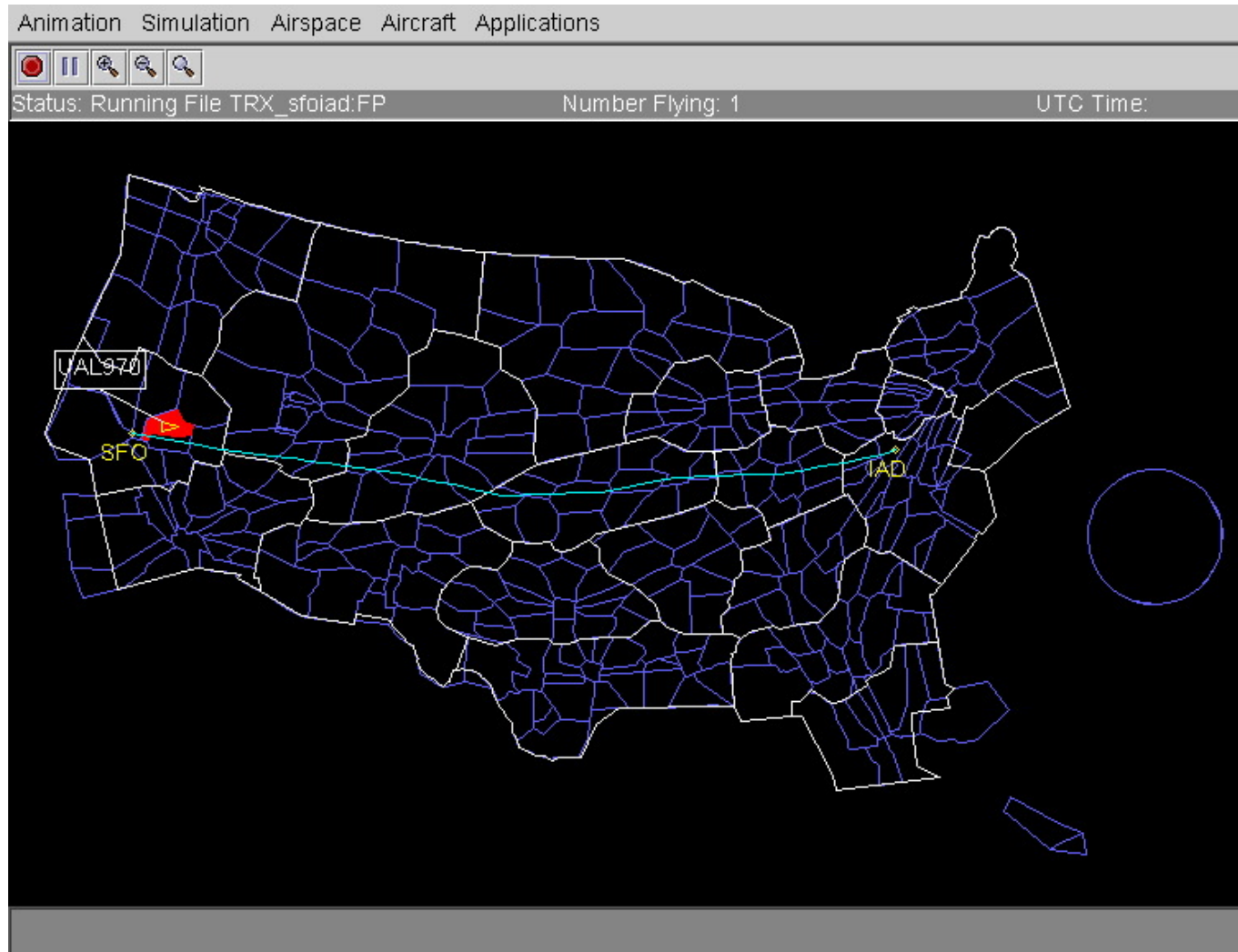
Outline

- **VAMS Project Description**
- **VAMS Project Management**
- **VAMS Project Schedule**
- **Technical Interchange Meeting**
- **Objectives**
- **Agenda**

Background: Today's ATS Operational Concept Baseline

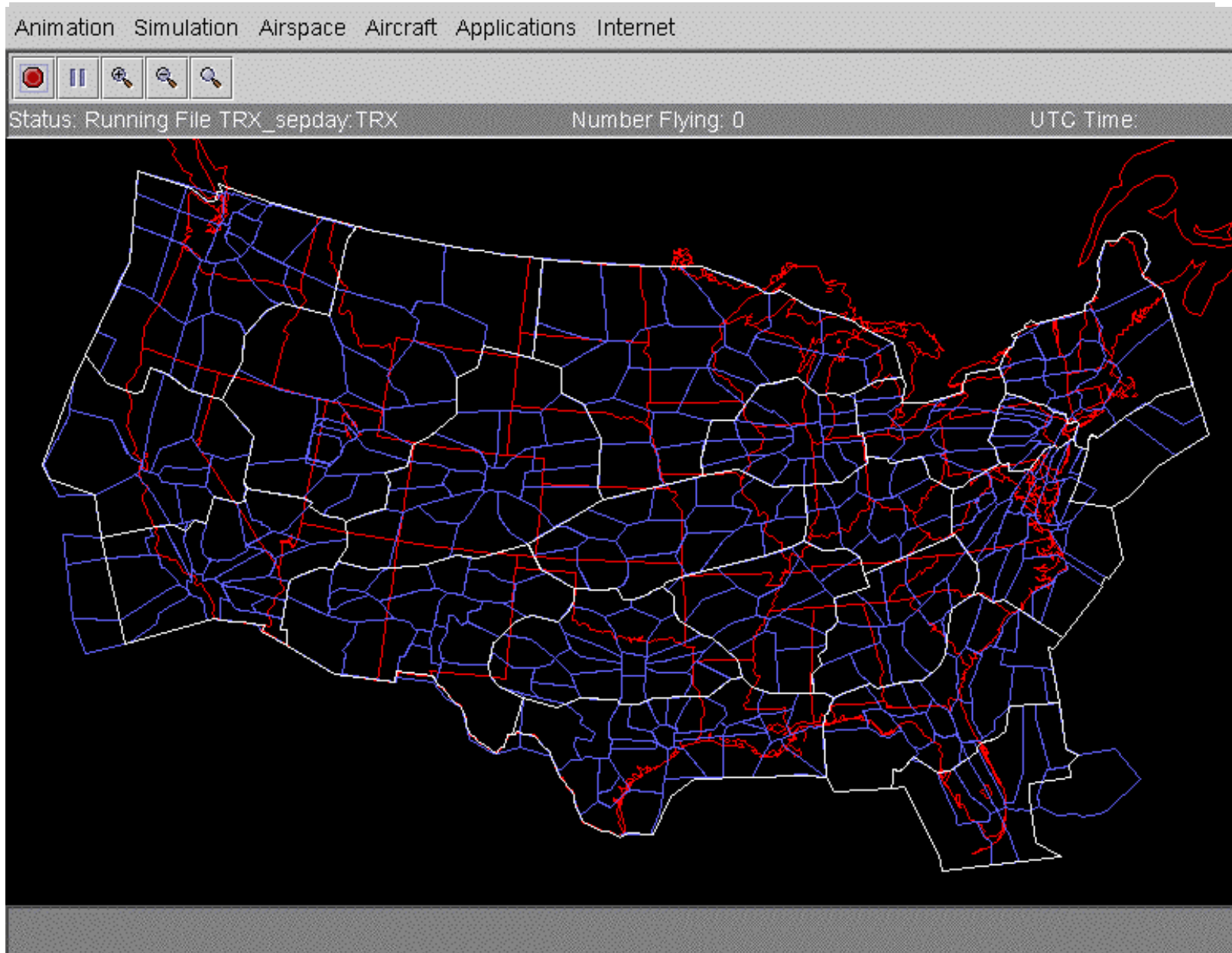


Flight from San Francisco to Dulles



- Route of flight includes transition through 35 sectors:
- 6 surface/terminal area sectors (departure)
 - 23 en route area sectors
 - 6 terminal/surface area sectors (arrival)

Off Nominal ATM Scenario

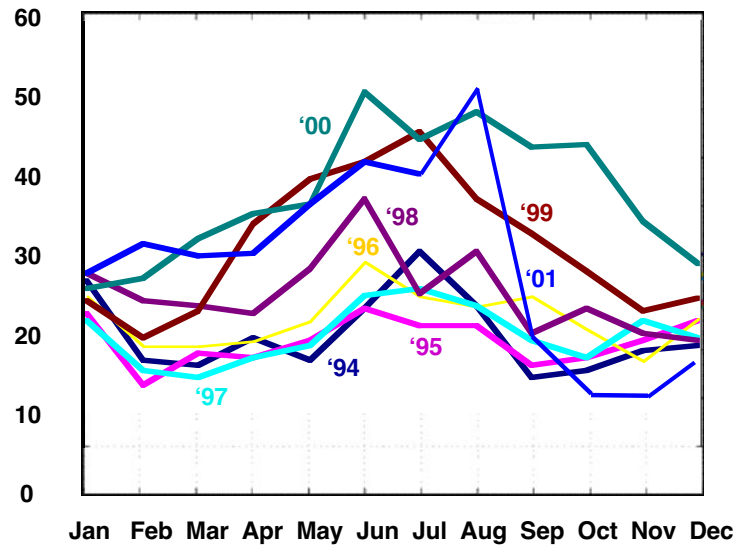


Project Goals & Objectives

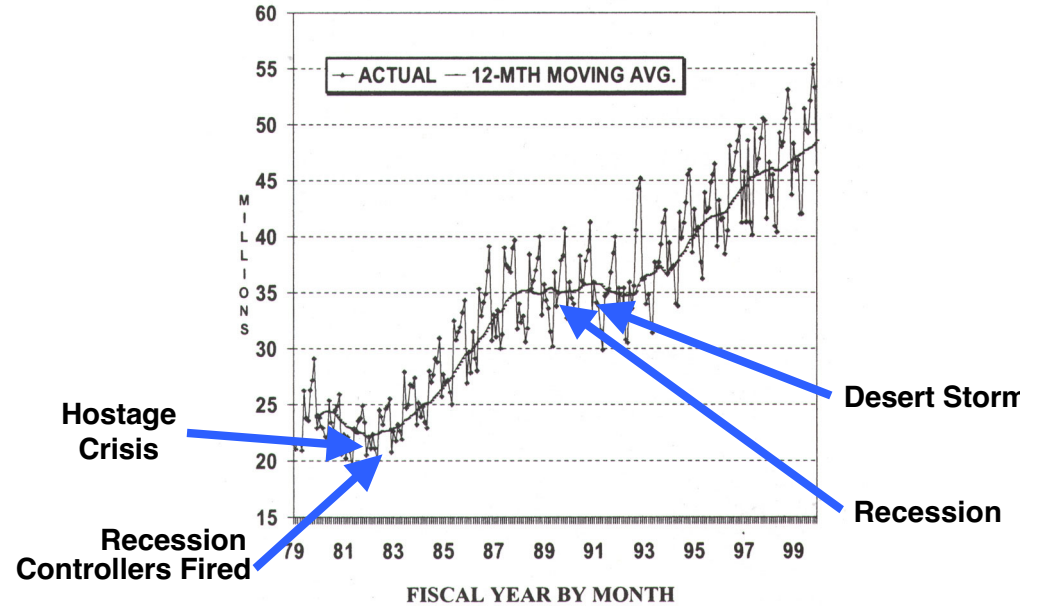
- **Develop the capability to model and simulate behavior of air transportation system concepts and their elements to never-before-achieved levels of fidelity**
 - Develop a set of analytical and computational models and methods to conduct detailed assessments of candidate operational concepts
 - Establish simulation capability that will enable safe investigation of complex advanced air transportation concepts, and develop a deeper understanding of human performance interaction within it
- **Develop advanced air transportation concepts**
 - Develop a set of potential operational concepts, concepts of use, and architectures, providing definitions of the future air transportation system and its elements
 - Develop technology roadmaps to achieve these concepts
- **Conduct assessments of advanced air transportation concepts**
 - Address potential benefits, identify risks and limits, and evaluate performance, safety, operations, and National Airspace System infrastructure and transition challenges

Air Transportation System Status

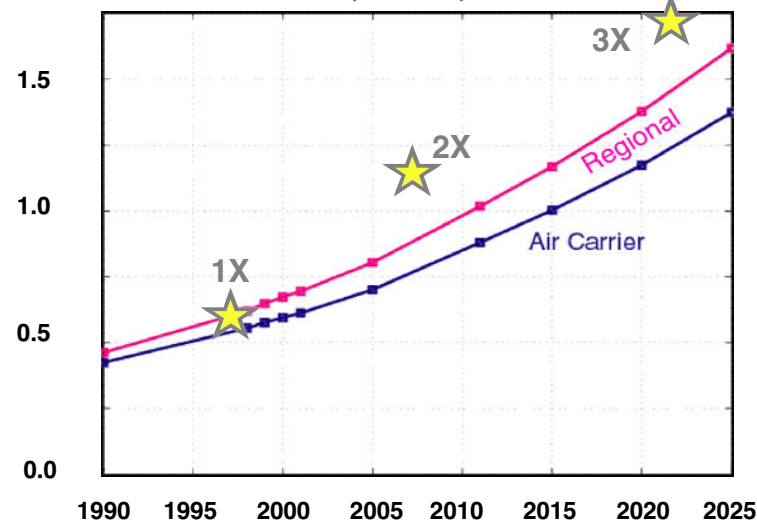
TOTAL U.S. ATC SYSTEM DELAY
(Thousands of Flights with Delay > 15 mins)



MONTHLY PASSENGER ENPLANEMENTS
(Millions)



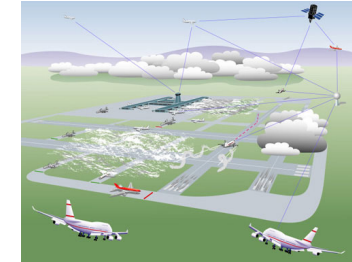
ANNUAL PASSENGER ENPLANEMENTS
(Billions)



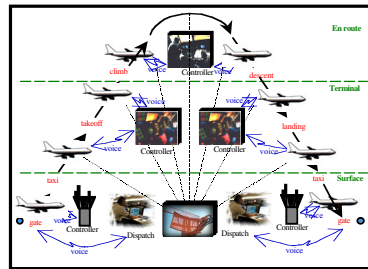
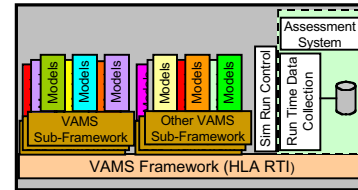
- **The National Airspace System (NAS) on the verge of gridlock**
 - Excessive delays result
 - Negative impact on economy and mobility
- **New concepts beyond currently planned are needed to meet future capacity demands**
- **Substantial change is required in the approach to NAS operations**
- **Total NAS evaluation requires substantial improvement to current modeling and simulation capabilities**
- **NASA has extensive experience in airspace systems development and an outstanding modeling and simulation capability**

Project Summary

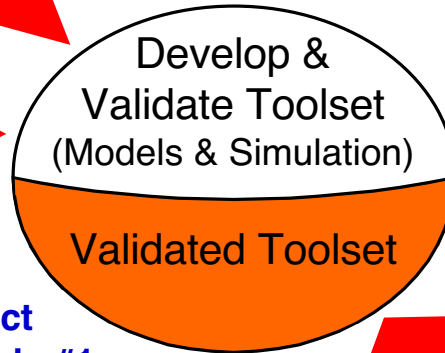
Set of Operational Concepts



Improved Models

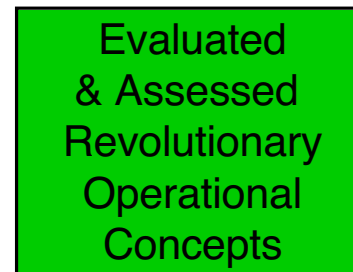


Baseline



Project Deliverable #1

Project Deliverable #2



Project Deliverable #3



Virtual Airspace Modeling & Simulation - Technical Interchange #1

Terms & Definitions

Operational Concept: An operational concept describes what a specific set of air transportation system capabilities does or will do to provide specific operational services to an identified set of system users.

These operational services include:

- Flight Planning
- Situational Awareness & Advisory
- Traffic Management—Strategic Flow
- Traffic Management—Synchronization
- Infrastructure/Information Management
- Separation Assurance
- Navigation & Landing
- Airspace Management
- Emergency/Alerting

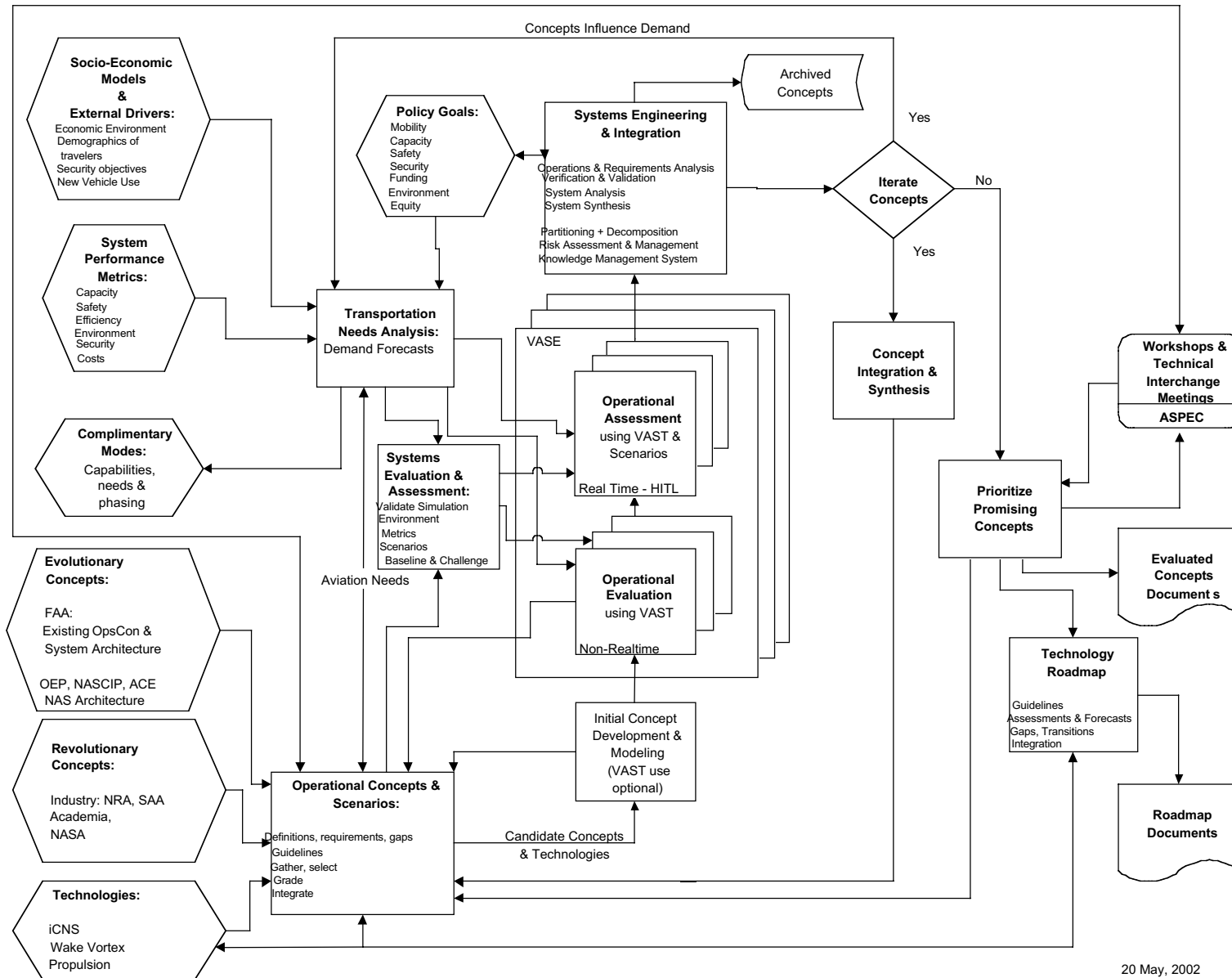
An operational concept may be limited to a subset of these services and the technology used to accomplish that concept; for example, the operational concept might be “the air transportation system provides separation assurance between aircraft”

Modeling: A set of mathematical constructs or equations and parameters that describe a phenomenon or concept

Simulation: The time-based integration of models that use the passage of time as one of its parameters

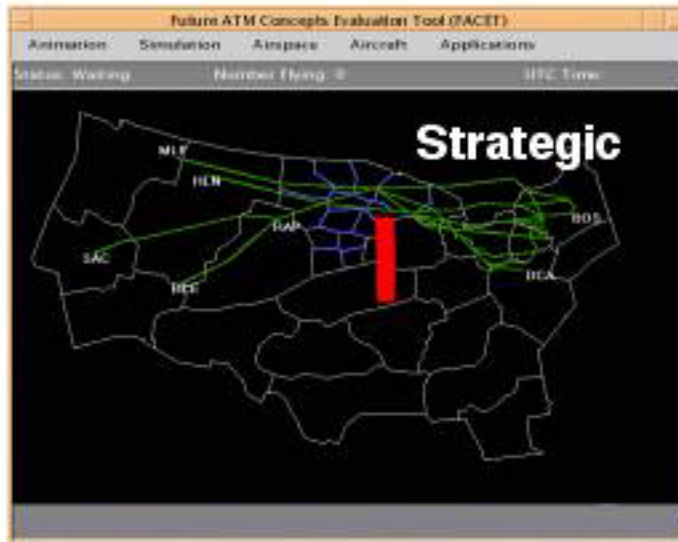
Real-Time: Simulations in which the passage of time replicates the passage of time in the ‘real’ world associated with human-in-the-loop (HITL)

Non Real-Time: Simulations in which the passage of time is either slower or faster than the real world

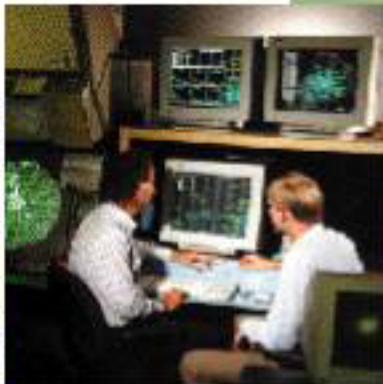


Technical Challenges

- Identifying and prioritizing a set of existing models
 - Developing models to fill gaps
 - Integrating and validating the set of models
 - Integration with human-in-the-loop simulation and validation
- Modeling & Simulation
- Using appropriate evaluation methods
 - Defining gate-to-gate and door-to-door measurable metrics
 - Supporting and defining appropriate scenarios (utilization)
- Evaluation & Assessment
- Identifying Enterprise goal-achieving concepts
 - Comprehensive modeling and analysis of concepts and supporting technologies
 - Seamless integration of concept elements
 - Knowledge management
 - Technology/concept assessments
 - Information flow
- Operational Concept & Analysis



Regional

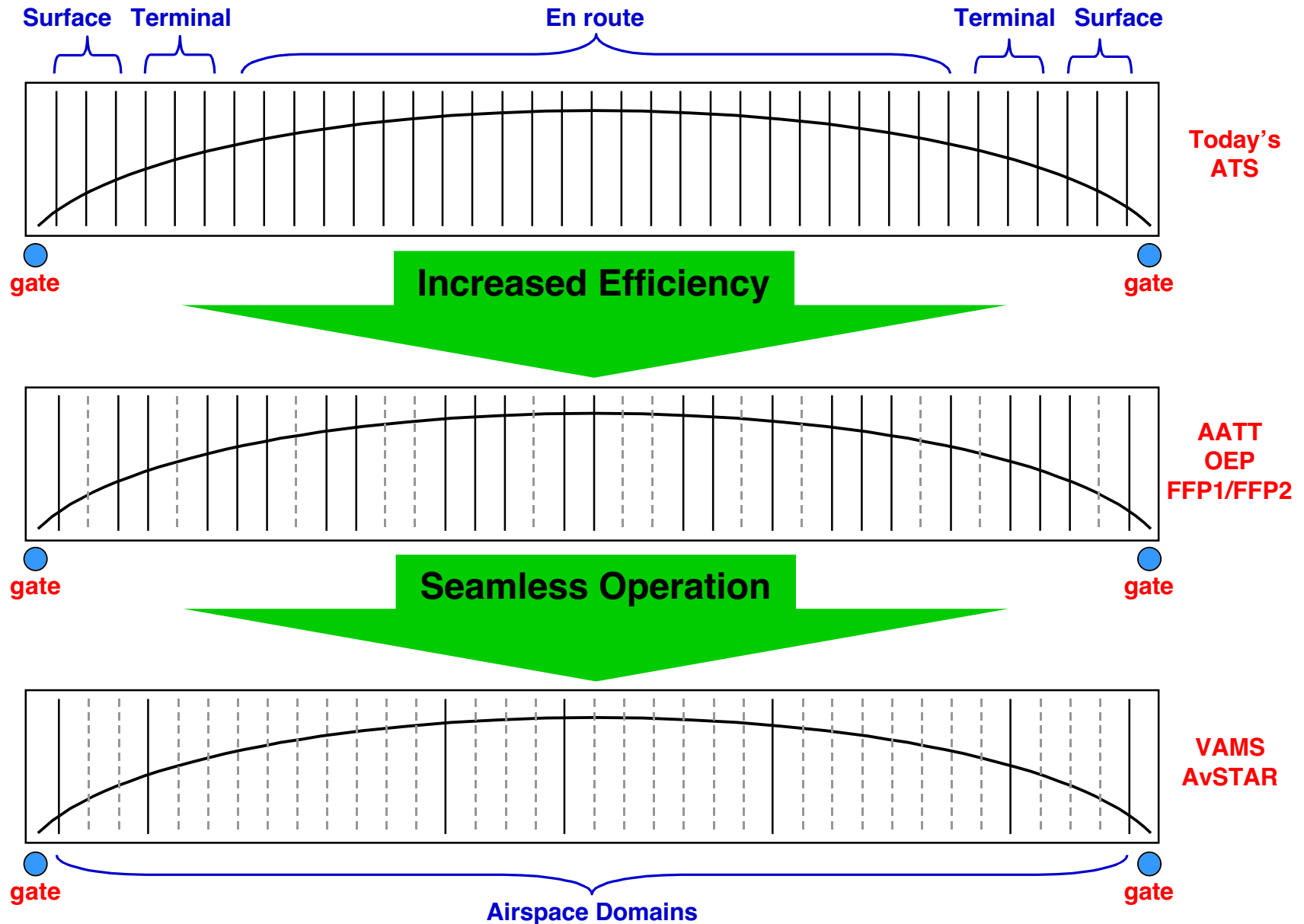


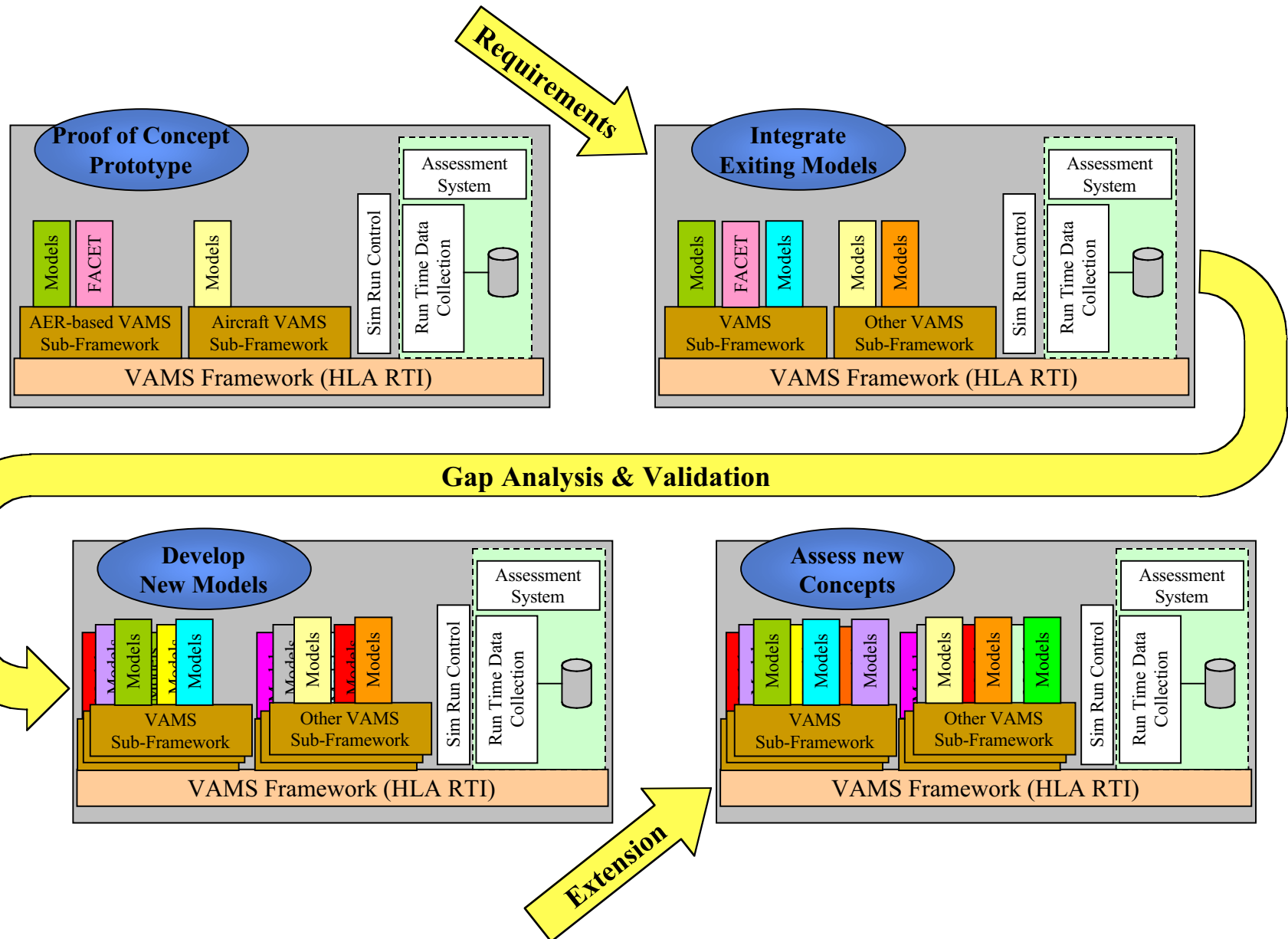
Tactical



Future Operational Concept Paradigm Shift

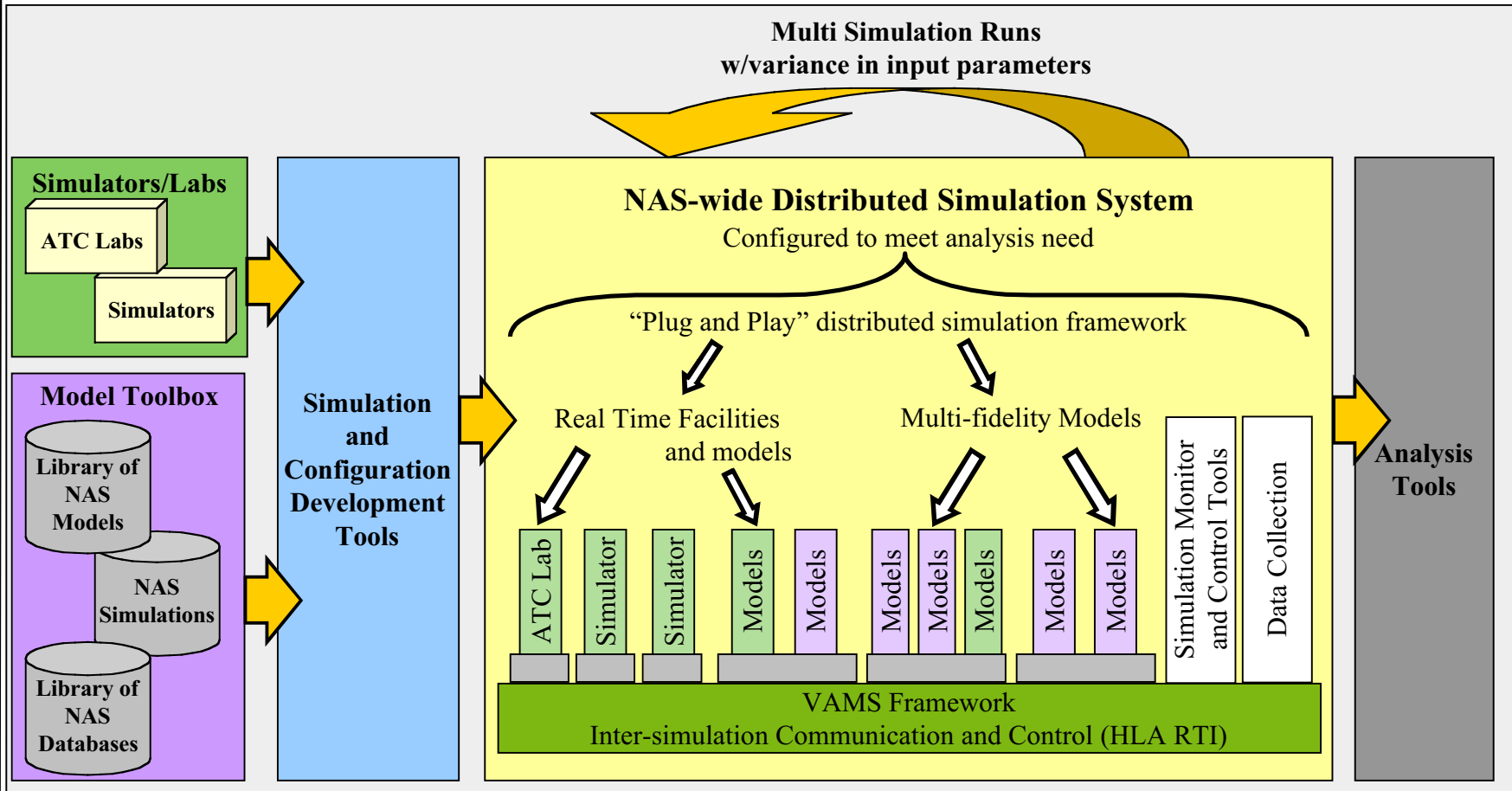
Virtual Airspace Modeling & Simulation - Technical Interchange #1





Future NAS-Wide Simulation Analysis Architecture

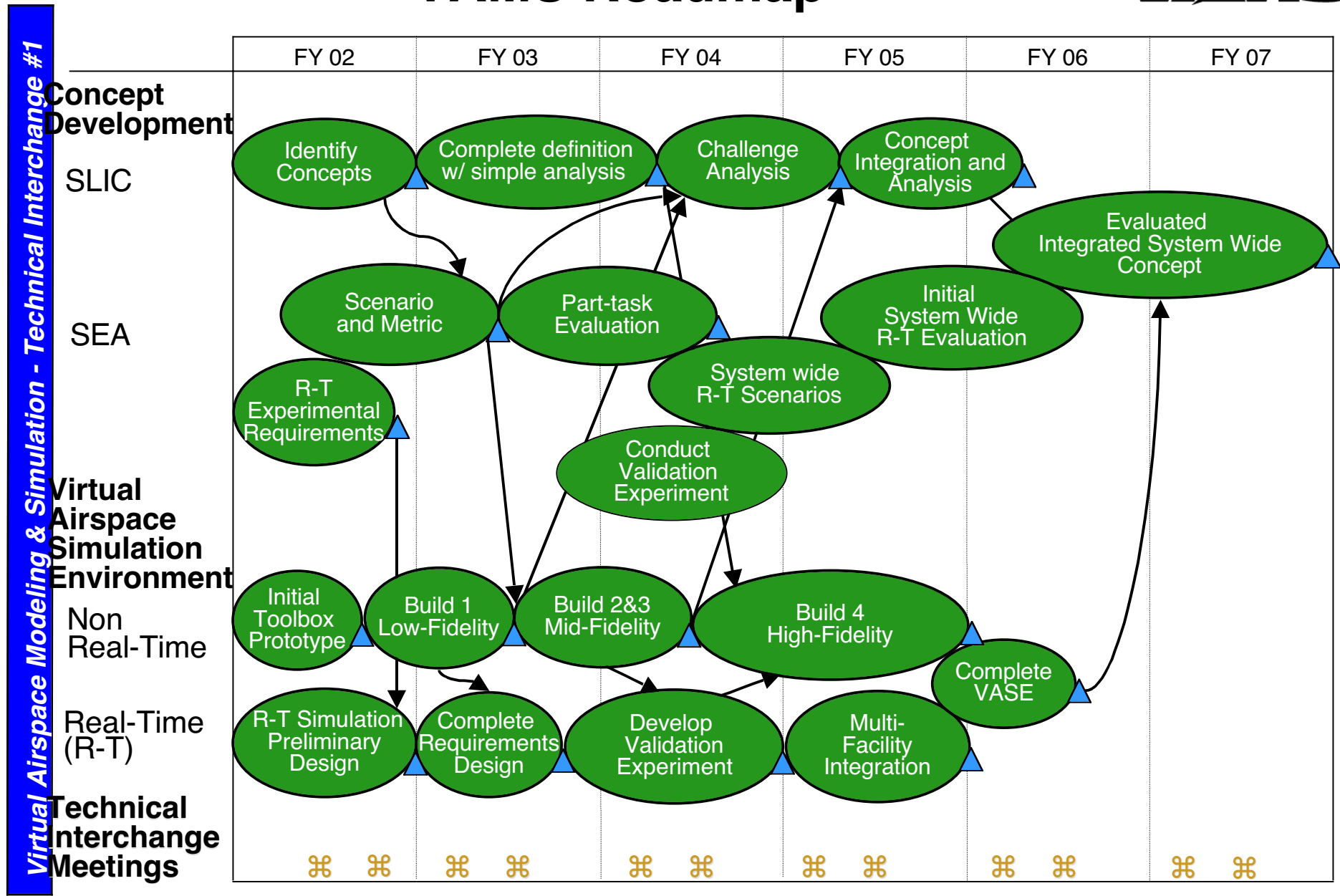
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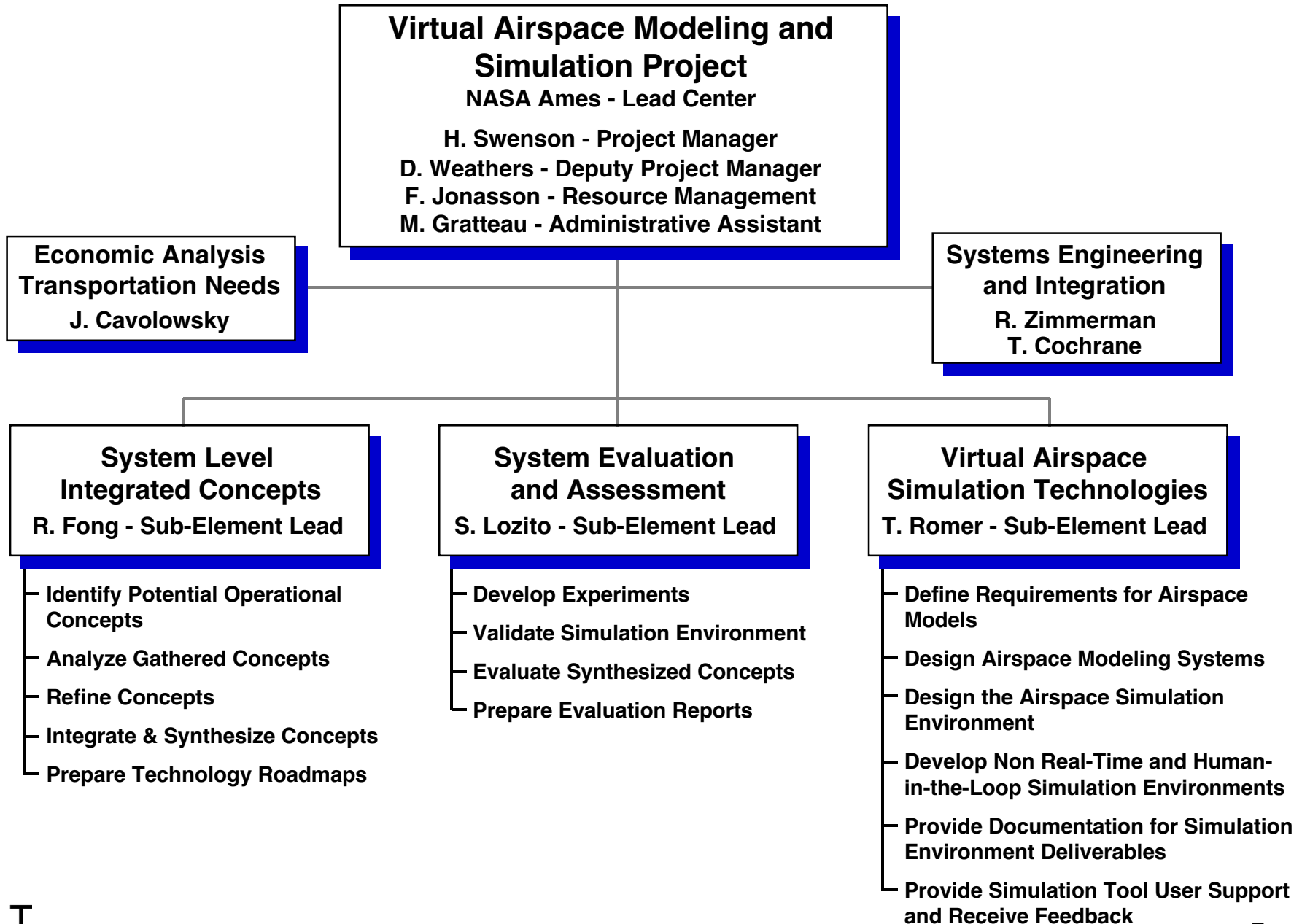
Approach provides an open architecture embracing best-of-breed models and simulations, and sockets for facilities in a NAS-wide, multi-fidelity framework

- **Deliverable #1** – A real-time virtual airspace simulation environment **(3QFY06)**
 - Annual build of simulation capability
- **Deliverable #2** – The identification and evaluation of potential concepts of operation that meet the objectives of the Enterprise's long-term capacity and mobility objectives of the *Revolutionize Aviation* Goal **(3QFY07)**
 - Interim deliverables on a yearly basis
- **Deliverable #3** – Technology roadmaps to achieve the identified concepts **(3QFY06)**
 - Interim deliverables on a yearly basis

VAMS Roadmap



VAMS WBS Management Structure



- Project integration and risk management
- Initial air transportation system concept information definitions
- Initial technology roadmap definition and development
- Initiate evaluation scenarios and metric definition and development
- Guideline development for concepts assessment

TIM Agenda

21-May Tuesday	22-May Wednesday	23-May Thursday
Facility opens and Meeting Registration	Facility opens	Facility opens
	Daily Agenda	Daily Agenda
NASA Welcome (Jacobsen)	Automated Airport Surface Traffic Control <i>Metron</i>	Breakout #2: Metrics/Scenarios (3 separate parallel sessions)
VAMS Project overview (Swenson)	Surface Operation Automation Research <i>Optimal Synthesis</i>	
SLIC Sub-element overview (Fong)	Centralized Terminal Operation Control <i>Northrop Grumman</i>	
Break	Break	Break
VAST Sub-element overview (Romer)	Air Transport System Capacity Increasing Concept <i>Raytheon</i>	Breakout report writing #2 with a parallel special topic -- VAST Prototype
SEA Sub-element overview (Lozito)	Wake Vortex Avoidance Concept (Rutishauser)	Report on Breakout #2
Federal Aviation Administration (Liang)	Advanced Airspace Concept (Erzberger)	Catered Lunch in Patio Room
Catered Lunch in Patio Room	Catered Lunch in Patio Room	Catered Lunch in Patio Room
System Level Capacity Increasing Concept <i>Boeing</i>	University Concepts (Zellweger)	Breakout #3: Guidelines (3 separate parallel sessions)
Technologies Enabling All-Weather Max. Cap. By 2020 <i>Metron</i>	Breakout #1: Technology Roadmaps (3 separate parallel sessions)	Break
Break		Breakout report writing #3 with a parallel special topic -- Business Modeling
Massive PTP & On-Demand ATS Invest. <i>Seagull Tech.</i>	Break	Report on Breakout #3
System Wide Optimization (Sridhar)	Breakout report writing #1 with a parallel special topic -- Distributed Air Ground	Next Steps in Concepts and a Preview of TIM 2
Special Breakout Session: Facilitator/Recorder Meeting (others adjourn for day)	Report on Breakout #1	

- Phone Calls

Messages can be left at (650) 604-2926 or 604-2082

- Computing

MacIntosh computers and hookups for laptops are available for your use in the Fireside area.

- Refreshments & Registration

- Breakout Assignments

- ★ Macon
- ★ Northwing
- ★ Showroom

- Restrooms

Located on the right side of the ballroom and on your left just as you past the registration area.

Questions, Comments, Issues

Background: Air Transportation System

Virtual Airspace Modeling & Simulation - Technical Interchange #1

Origin



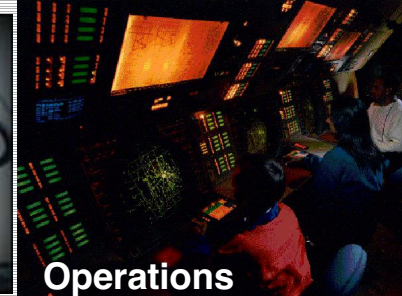
Safety



Technology



Operations

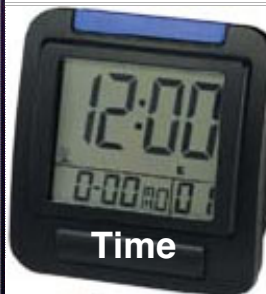


Mobility

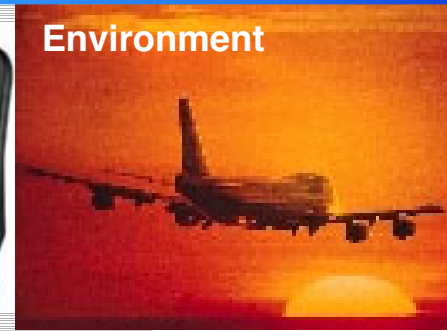
Information



Time



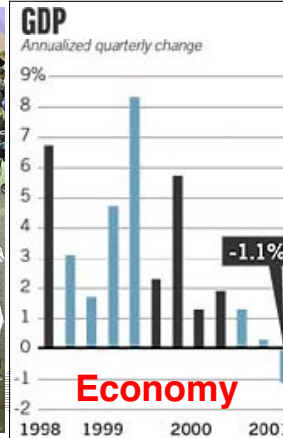
Environment



Energy



Security



Economy

Infrastructure



Destination

